

COTS Status

NASA Advisory Council Ames Research Center August 2, 2011

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Program Manager Commercial Crew & Cargo Program



COMMERCIAL CREW & CARGO

Program Status



- Both SpaceX and Orbital continue to make steady progress toward completing their COTS demonstration flights, but have experienced schedule delays due to typical development challenges and augmented ground test plans. Most recently:
 - Space Exploration Technologies (SpaceX):
 - Successfully completed its first COTS demonstration mission on December 8, 2010
 - Remaining demonstration flights for NASA (C2 and C3) are scheduled for November 2011 and March 2012
 - NASA is evaluating proposal for accelerating C3 mission objectives (ISS berthing) on C2 flight
 - Provides additional opportunity to demonstrate berthing with the ISS and potentially accelerate cargo services
 - Orbital Sciences Corporation (Orbital):
 - Has begun integration of the Cygnus Service Module in Dulles, VA and the Taurus II launch vehicle at NASA's new Horizontal Integration Facility at Wallops Flight Facility
 - Orbital is preparing for a maiden test flight of the Taurus II in December and its ISS demonstration flight is scheduled for February 2012
 - Experienced AJ-26 engine fuel line failure during accepetance testing at SSC in June
 - Developing inspection and repair techniques to disposition remaining engines

Cargo Augmentation Funding Summary



- \$288M additional funding was authorized and appropriated in FY11 to reduce risks associated with the remaining development and timely demonstration of cargo space transportation capabilities
- Augmentation milestones were amended into the SAAs to accomplish the following:
 - SpaceX
 - Pressurized Cargo Environment Modal Test
 - LIDAR Sensors 6 Degree of Freedom Testing
 - Solar Array Deployment Tests
 - Spacecraft Thermal Vacuum System Test
 - Infrastructure Enhancements (Launch, Test and Production sites)
 - Acoustic and EMI Tests
 - Enhanced Powered Cargo Accommodations
 - Orbital
 - Addition of Taurus II Maiden Flight
 - Processor in the Loop (PITL) Simulators
 - PROX FEU Test Unit Simulators

SpaceX Recent Progress



 27 of 40 Milestones completed for a total of \$313M out of \$396M NASA payments



Dragon 2 in Final Assembly



Dragon 2/Trunk

SpaceX Recent Progress (Cont.)





Cargo Rack



Trunk to Dragon "Claw"



PCBM Fit Check



Solar Array

SpaceX Recent Progress (Cont.)





F9-3 2nd Stage

SpaceX COTS Milestones



		\$M	\$M	20	006		200	07			20	08			20	09			20	10			20	11			20 ⁻	12	
	Milestones		Total	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
		278.0																											
1	Project Mgmt Plan	23.1	23.1		Sep 1	<u> </u>] - -				 											
2	Demo 1 SRR	5.0	28.1		N	ov 29																							
3	Demo 1 PDR	18.1	46.2			F	eb 8							i 		 		i 						 					
4	Financing Round 1	10.0	56.2				Mar 1											i 				<u> </u> 							
5	Demo 2 SRR	31.1	87.4				Mar 15			 				ļ Ļ				ļ 				<u> </u>							
6	Demo 1 CDR	8.1	95.5					Αι	ıg 22					 				! ! !											
7	Demo 3 SRR	22.3	117.8						Oct	29				 				<u> </u> 				 							
8	Demo 2 PDR	21.1	139.0			<u> </u>				Dec 1	9			<u>i</u>				<u>i</u>				<u> </u>							
9	Draco Init. Hot fire	6.0	145.0			ļ					Mar 21			ļ ļ				! ! !				ļ							
10	Financing Round 2	10.0	155.0			<u> </u>					Mar 21			ļ								! !							
11	Demo 3 PDR	22.0	177.0			ļ				Apr				ļ				<u> </u>				ļ							
12	Multi-Engine Test	22.0	199.0			<u>.</u>					Aug	4	Sep	<u> </u>				<u>.</u>				<u> </u>							
13	Demo 2/3 CDR	25.0	224.0			<u> </u>						Dec	18	Jan				<u> </u>				<u>.</u>							
14	Financing Round 3	10.0	234.0			ļ 							Feb	В	Mar			<u> </u>				<u> </u>							
15	Demo 1 RR	5.0	239.0						Feb	V				┝╲	 Mar				-	Jun 8		ļ							
16	CUCU Flight Unit	9.0	248.0			<u> </u>								M	ay	→ VJı	ul 23	<u> </u>				<u> </u>							
17	Demo 1 Mission	5.0	253.0									Sep ;			- *V	Jun_		 		 		Dec 1	15		,				
18	Demo 2 RR	5.0										l	Dec			-	Sep	 					<u> </u>	Sep	Oct				
19	Demo 2 Mission	5.0				ļ								ļ	Jun		→ V _N	bv.							No	V			
20	Cargo Int. Demo	5.0	258.0			ļ								ļ		Dec	18	V Jan				ļ				7			
21	Demo 3 RR	5.0													Jul		>	Jan							- 🍑	Dec			
22	Demo 3 Mission	5.0														Sep		<u> </u>	Mar		<u> </u>	 			Jan	V	Mar		



Current Plan

Actual Completion Date



Initial SAA Plan





SpaceX Augmented COTS Milestones



	\$M	\$M	2007					20	80			20	09			20	10			20	11			20	12	
Milestones		Total	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	<u>118.0</u>										! !								<u>į</u>				 			
23 Modal Test Plan	5.0	5.0					<u> </u>								i 				Dec 16	5			i ! !			
24 Modal Test	5.0	10.0					 				 - 				 				Dec 10	6			 			
25 LIDAR Test (open loop)	5.0	15.0					ļ 				 				! ! !				Dec 10	6			 			
26 Solar Array Deploy Test	5.0	20.0									ļ !								Dec 1	6			 			
LIDAR Test Plan 27 (closed loop)	5.0	25.0					 				 				 					Mar 31			 			
Thermal Vacuum Test 28 Plan	5.0	30.0																	Mar	Ar	or 6					
29 Infrastructure Plan	10.0	40.0																		7	May 10					
30 Thermal Vacuum Test	20.0				 		! ! !				 				! ! !				<u> </u>	Ju	V∵ A	ug	 			
Test site Infrastructure 31 Implementation	5.0	45.0																			Jun 23					
Dragon Trunk Acoustic 32 Test	10.0	55.0																			Jun 23		 			
LIDAR Test 6 DOF 33 (closed loop)	5.0						† 				! !				! !						ug	Sen				
Design Rev. Enhanced 34 Powered Cargo Accom.	5.0										! ! !								ĺ		VAI					
Design Rev. Pressurized 35 Cargo Vol Increase	5.0						† 												-		VAI		 			
Dragon EMI/EMC Test 36 (HITL)	10.0						ļ				 				 				ļ	Jul	V3. 7					
Dragon Cargo Racks & 37 Hatch Simulator	3.0						<u> </u>								i				<u> </u>	- Ou.	∇		 		••••••	
Ground Demo Enhanced 38 Powered Cargo	5.0						ļ !				 				 				ļ		∇	ug	 			
Launch site Infrastructure							 				ļ				 						∇	Sep	 			
39 Implementation Production Infrastructure	5.0						<u> </u>												<u> </u>		V	Sep				
40 Implementation	5.0						<u> </u>				i !				<u> </u>				<u> </u>		V	Sep	i !			
SAA Total	206.0	313.0					ļ				 				 				ļ				 			
SAA TOTAL	<u>396.0</u>	<u>313.0</u>					<u> </u>				<u> </u>				i				<u>i </u>				<u> </u>			





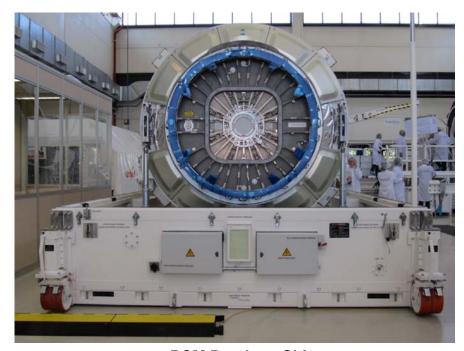




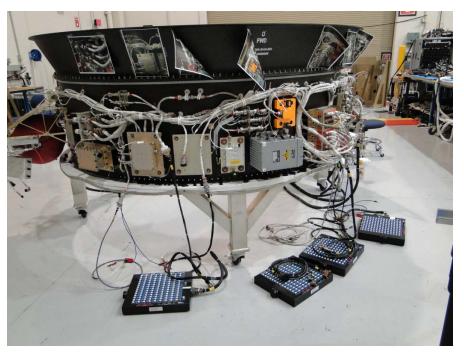
Orbital Recent Progress



 23 of 29 total Milestones completed for a total of \$261.5M out of \$288M NASA payments



PCM Ready to Ship



Cygnus Avionics Testing



Launch Pad Under Contruction at WFF

Orbital Recent Progress (Cont.)





TII Vehicle Processing at WFF HIF

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Orbital COTS Milestones



	\$M	\$M		20	08			20	09			20	10			20	11		2012			
Milestones		Total	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	<u>170.0</u>			,											i i							
1 Program Plan Review	10.0	10.0	V	Mar 31							 				 				 			
2 Demo Mission SRR	20.0	30.0		Jun	Jul 1	7					 				 				 			
3 UCM PDR	10.0	40.0		Ju	ı 🗸 A	ug 14					 				 				 			
4 DELETED											 				 				! ! ! !			
5 COTS Int/Ops Facility	10.0	50.0		s	ep 22	Oc	t				 				<u> </u> 				 			
6 PCM PDR	10.0	60.0			Oct 9		ον				! ! !				! ! !				! ! ! !			
7 DELETED											<u> </u> 				 				! ! !			
8 IP&CL Submission	10.0	70.0					F	eb 18			 				 				 			
9 ISS Phase 1 SRP	10.0	80.0						Mar 2	7													
10 COTS System PDR	20.0	100.0			Sep		– – – Ap	r N	lay 22													
11 PCM CDR	10.0	110.0			-				Jul	31	i ! !				i ! !				i ! !			
12 Cygnus Avionics Test	10.0	120.0						Jun	<i>-</i>	Aug 13	 				 				 			
13 ISS Phase 2 SRP	10.0	130.0							Aug	- -	ov 6				 				! ! ! !			
14 COTS System CDR	10.0	140.0					Mar		 Sep	7		Mar 23			 				 			
15 SM Core Assembly Complete	7.5	147.5							Oct	/-	Dec		A	ug 30	! ! !				! ! !			
16 SM Test Readines Review	7.5	155.0								Jan	√ ▶	V Apr		- N	i ojv 17				 			
17 SM Initial CPT	5.0										i 	May .			<u> </u>	▶ Jun	- 🕌	Sep				
18 LV Stage I Assy. Complete	2.5												Sep		<u> </u>		Sep	7+	Jan			
19 Cargo Int. Demo	2.5	157.5									 		-		Dec 6							
20 Mission Readiness Review	2.5										 		Oc	₩ - ·	<u> </u>			V	Jan			
21 System Demo Flight	2.5										 			Dec				Dec	→ ./ _F	eb		









Initial SAA Plan





Orbital Augmented COTS Milestones



	\$M	\$M		2008					09			20	10			20	11			20	12	
Milestones		Total	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	<u>118.0</u>										i I I											
22 TII Test Flight Mission Review	20.0	20.0					 				 			V	Dec 15							
23 TII Test Flight Mission Analys.	10.0	30.0					 				 			ļ	Fe	b 23						
24 Cygnus Mass Sim. (CMS) DR	10.0	40.0					 				 					Mar 03						
25 Install Add'l PITL Simulators	5.0	45.0									 				Apr	M:	ay 6					
26 PROX FEU Test Unit	5.0	50.0									ļ 				<u> </u>	lay	Jun 17					
27 TII Maiden Flt Stg 1 Core Del.	24.0	74.0													<u> </u>	Apr	28					
28 TII Maiden Flt Uppr Stage Del.	20.0	94.0									i ! !				<u> </u>	V	Jun 21					
29 TII Maiden Flt CMS Delivered	10.0	104.0									i ! !					V	Jun 20					
30 TII Maiden Flt Stage 1 Assy.	10.0						 				 				! !		V-Jui	No	v			
31 TII Maiden Flight	4.0										 						Oc	\	Dec			
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SAA Total	288.0	<u>261.5</u>									i ! !] 							





Initial SAA Plan

